Integrated Strategies for Fossil Generation Emission Reduction

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Abstract

Because disruption of the climate is a function of cumulative atmospheric loadings of global warming emissions over time, today's investment patterns in energy production and consumption equipment have a lasting impact on mankind's ability to avoid the more serious consequences of climate forcing. Due to its abundance and relatively low direct costs, coal is likely to remain an attractive energy resource to industrialized and developing economies for decades longer. To avert lock-in of large amounts of cumulative CO_2 emissions we need early adoption of measures to avoid investments in new coal generating plants that cannot economically capture their CO_2 emissions. When these measures are coupled with programs to reduce electricity demand growth and accelerate penetration of renewable resources, it is possible to avoid very substantial amounts of cumulative emissions over the next several decades.

The International Energy Agency (IEA) forecasts that from 2003-2030 nearly 1400 GW of new coal plants will come on line. Using moderate assumptions about emission rates, capacity factors, and operating life, the cumulative CO2 emissions from these new coal plants will be about 145 billion metric tonnes (Gt) of carbon—an amount equal to half the total carbon released globally from all fossil fuel combustion since 1751. When new natural gas plants are considered (nearly 1900 GW of new capacity with cumulative emissions of over 60 Gt C), the carbon commitment from these fossil generation investments is nearly 75% of fossil combustion CO_2 emissions since 1751. Investments locking in this amount of cumulative CO_2 emissions will make stabilization of global warming emissions at prudent levels impossible.

This presentation examines the impacts of two plausible action plans that could help to avert such lock-in: a global program and a compatible program focused on the U.S. In the global scenario, we combine the IEA's Alternative Policy Scenario (APS) from its World Energy Outlook 2004 with an initiative to finance the construction of coal gasification plants with CO_2 capture and storage (CGCC+CCS) instead of conventional coal plants starting in 2011. Enhanced energy efficiency and, to a lesser extent, renewable energy increases in the IEA APS dramatically reduce the required new coal build compared to the reference case forecast: global new coal build is nearly cut in half for the period 2011-2030. New natural gas capacity is cut by 17% and non-hydro renewable capacity increases by 41% compared to the reference forecast. The APS reduces 2030 emissions from all fossil sources of carbon by 1.8 Gt below the reference forecast, a 41% reduction in the reference case emissions *growth* from 2002. For emissions from coal power and heat plants, the APS produces an even more dramatic 64% reduction in emissions growth.

When the IEA APS case is combined with an initiative to build CGCC+CCS in place of conventional coal, there are large additional immediate reductions in emissions and even larger benefits in avoiding the long-term carbon lock-in associated with conventional coal capacity. Under the APS case there are still 610 GW of new coal capacity forecast to be built from 2011-2030, which would have annual emissions of 1.1 Gt C in 2030 and lifetime emissions of 64 Gt if all their CO_2 were released. With a successful CGCC+CCS deployment initiative covering 80% of new coal built from 2011-2020 and 100% thereafter, the lifetime emissions of this new capacity would be reduced to 15 Gt C and annual emissions in 2030 from this new capacity would be 0.25 Gt C instead of 1.1 Gt.

Thus, an integrated strategy of efficiency, renewable energy (EERE) and accelerated deployment of CGCC+CCS can achieve significant reductions in BAU emissions in the next 25 years and even larger reductions in the lifetime CO_2 emissions from new fossil plant investments made during that period. In addition to delivering emission reductions, the EERE program reduces the costs of the accelerated CGCC+CCS deployment program by substantially reducing the amount of new coal capacity that is covered under the program.

A second mitigation scenario focuses on the U.S. and outlines a program to cut U.S. emissions by 50% from forecast 2010 levels by the year 2050. The program is assumed to begin in 2010 and ramp up over the following 40 years. The scenario consists of a portfolio of efficiency measures in the electricity, industrial, and transportation sectors, a significant expansion of wind power, a significant biofuels program for transportation, and a significant deployment of CGCC+CCS. Together, these measures would reduce U.S. CO_2 emissions from 1.8 Gt C in 2010 to 0.9 Gt C in 2050, compared to a base case forecast of 2.6 Gt C in 2050. The energy efficiency programs are responsible for just over 60% of the emission reductions, while the renewable energy and CGCC+CCS programs are responsible for just under 20% each. As with the global example, this hypothetical U.S. program indicates that major reductions from BAU emissions paths are achievable using known technologies and that a combination of measures avoids placing an unmanageable degree of reliance on any one mitigation method.